International Journal of Agricultural Science and Research (IJASR)
ISSN(P): 2250-0057; ISSN(E): 2321-0087
Vol. 9, Issue 4, Aug 2019, 199-208
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THE SCREENING OF VARIETY/VARIETIES OF STRAWBERRY SUITABLE FOR ASSAM CONDITION

TILAK MALAKAR[1], D. N. HAZARIKA[2], S. LANGTHASA[3], R. K. GOSWAMI[4] & M. K. KALITA[5]

[1, 2, 3]*Department of Horticulture, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali, Assam, India*

[4] *Department of Crop Physiology, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali, Assam, India*

[5]*Department of Plant Pathology, Biswanath College of Agriculture, Assam Agricultural University, Biswanath Chariali, Assam, India*

ABSTRACT

The present investigation was carried out in the Instructional cum Research Farm, Department of Horticulture, Biswanath College of Agriculture, AAU, Biswanath Chariali during 2015-16 to find the variety/varieties suitable for Assam condition. The experiment was laid out in a Factorial Randomized Block Design having three environmental conditions viz. Open condition (S_1), Poly house (S_2) and in Net house (S_3) with five varieties i. e. Cristal (V_1), Subarina (V_2), Sweet Charlie (V_3), Winter Dawn (V_4) and Eliyana (V_5) with three replications. The study revealed that the variety "Subarina" recorded maximum plant height (18.62 cm), plant spread (27.36 cm), produced maximum number of leaves (18.42), longest leaf (8.39 cm), longest petiole (9.12 cm) and maximum number of crowns (5.53). The maximum leaf breadth (13.57 cm) and maximum achene density (19.12/cm^2) was recorded in variety "Cristal". Significantly highest fruit length (4.08 cm), fruit diameter (3.09 cm), number of fruits per plant (18.04), weight of fruits (16.45 g), fruit production (297.33 g/plant) and yield (14.72 ton/ha) were recorded in Subarina. The variety "Subarina" performed well in all the environmental conditions as compared to the other varieties. The results of the experiment revealed that the performance in terms of vegetative growth and production of fruits were superior in Subarina as compared to other four varieties.

KEYWORDS: Strawberry, Environmental Conditions, Vegetative Growth & Production

Received: May 17, 2019; **Accepted:** Jun 06, 2019; **Published:** Jun 29, 2019; **Paper Id.:** IJASRAUG201926

Original Article

INTRODUCTION

Strawberry is one of the most popular soft fruit and is cultivated in plains as well as in hills up to an elevation of 3000 metres in humid or dry regions. It is widely grown under protected and open condition in temperate and subtropical countries with maximum temperature of 22^0-25^0C in the day and 7^0-13^0C at night. The modern cultivated octaploid (2n=8x=56) strawberry (*Fragaria ananassa* Duch) originated in France in the seventeenth century and belongs to the family Rosaceae. The cultivated strawberry *Fragaria ananassa,* is a result of hybridization of two American species, *F. chiloensis* and *F. virginiana.* It is a delicious, refreshing and nutritious soft fruit with a distinct tantalizing aroma with wider adaptability. This crop is mainly grown in the temperate region. However, it can also be grown under sub-tropical climate and even at high altitudes of tropical

climate. With the development of several day-neutral cultivars, the area and production is increasing at a faster rate.

In India, strawberry is confined only to the Hilly Tracts of Himachal Pradesh, Uttaranchal, parts of Uttar Pradesh and Kashmir valley. However, its cultivation has spread to tropical and subtropical zones, where other states like Meghalaya, Sikkim and Mizoram have taken up the cultivation of this viable fruit. In India, the area and production of strawberry is increasing year after year.

Strawberry give quicker and very high remunerative returns per unit area on the capital investment, as the crop is ready for harvesting within six months of planting, so it is considered more profitable in the shortest possible time compared to other fruits. Plasticulture techniques can play very important role in the manipulation of microclimate favourable for its cultivation, furthermore these techniques could revolutionize its commercial cultivation for higher profitability in many regions of India.

METHODOLOGY

Geographical Location of the Experimental Site

The present investigation was conducted in the Instructional cum Research Farm, Department of Horticulture, Biswanath College Of Agriculture, Assam Agricultural University, Biswanath Chariali during 2015-2016. The experimental site was situated at 26°15′ N and 27°45′ S latitude and 91°42′ E and 95°30′ W longitude having an altitude of 104 m above mean sea level.

Selection of Planting Materials

Healthy tissue cultured planting materials with uniform crown and well developed root system were planted in Hill row system in 15-20 cm raised beds with plant to plant distance of 45 cm and row to row distance of 45 cm.

Layout and Experimental Design

The experiment was designed in Factorial Randomized Block Design having three replications. The runners were planted in three cultivation situation i. e. open condition, poly house condition and net house condition. There were 15 treatment combinations.

CULTURAL OPERATIONS

Field Preparation

The experimental area (open condition) was thoroughly ploughed followed by harrowing and levelling. In poly house and in net house, the plots were prepared by manual hoeing followed by leveling.

Pre-Planting Treatment and Planting of Strawberry Runners

The soil of each condition was treated with Captaf @ $3gl^{-1}$ to avoid soil borne pathogens. Mulching was done with black polythene sheet in all the plots of the three cultivation situations. Before planting, holes were made on the polythene sheet with a sharp blade at 45 cm x 45cm apart so that the planting materials can be planted by inserting in the holes. Healthy tissue cultured planting materials were then planted carefully.

Time and Method of Fertilizer Application

The recommended doses of fertilizers were applied by spraying at 15 days interval during the crop cycle.

Intercultural Operation and Aftercare

Being a shallow rooted crop, strawberry requires frequent irrigation in lesser amount of water. During the experiment, irrigation was done with water cane at 1-2 days interval considering the water requirement by the plants. As mulching was done, there were lesser emergence of weeds, thereby weeding was done as and when there were emergence of weeds. The disease infected plants in the early stage of experimentation were uprooted immediately and the gaps were filled up with healthy runners after taking proper sanitation measures. Dried leaves of the plants were cut and removed periodically.

Harvesting

Harvesting was done when half to three fourth of skin develops colour. Depending on the weather conditions, picking was done on every second or third day usually in the morning hours. Strawberries were harvested in small trays or baskets. They were kept in a shady place to avoid damage due to excessive heat in the open field.

Observations

Five uniformly grown plants in each plot were selected to record the observations on growth and yield parameters. Observations were recorded at the proper time during the crop cycle.

GROWTH PARAMETERS

Plant Height and Plant Spread

The average height of the plant was measured with a measuring scale from the crown level to the apex of primary leaves and results were expressed in centimeters. Plant spread was measured in two directions, that is, East-West (E-W) and North-South (N-S) and the mean was taken as the actual plant spread, average values were expressed in centimeter.

Number of Leaves per Plant, Leaf Length, Leaf Breadth and Petiole Length

Data on number of leaves were recorded from ten plants of two rows in the centre of the each bed and results were expressed as leaf number per plant. The length of the leaf was taken by measuring from the base of the leaf petiole to the tip of the leaf. The breadth of the leaf was taken by measuring at the widest portion of the leaf lamina. Leaf petiole lengths were measured with a measuring scale from the crown level to the junction of trifoliate leaves and results were expressed in centimeters.

Achene Density

Achene of strawberry fruit may be defined as a small, dry, one seeded fruit that does not open to release the seeds. To determine the achene density, pieces of one cm2 berry skin from three different sides of berry were taken and number of achene was counted. The results were expressed in number of achenes per square centimetre.

Number of Crowns per Plant

The numbers of crowns were counted in each plant selected for data collection and averages were calculated out.

YIELD PARAMETERS

Fruit Length, Fruit Diameter

The length of ten randomly selected fruits from each replication was measured in centimetre from calyx plug to

the pointed end or apex of the fruit. The diameter of ten randomly selected fruits from each replication was measured and the mean was calculated and expressed in centimetre (cm).

Number of Fruits per Plant, Weight of Fruits

The number of fruits was counted per plant at the time of fruit maturity. To ascertain the berry weight, ten berries from each treatment were randomly selected and average weight of berry was recorded on electronic balance and expressed as mean fruit weight in gram

Fruit Production (g/plant), Yield (t/ha)

The total fruit production in each treatment was recorded from ten plants per plot and yield per plant was calculated out and expressed as grams per plant (g/plant). The yield per hectare was calculated out and expressed as tonnes per hectare (t/ha) of each treatment in all the situations.

RESULTS AND DISCUSSIONS

Growth Parameters

Plant height, plant spread, number of leaves per plant, leaf length, leaf breadth, leaf petiole length, achene density and number of crowns per plant were considered as growth parameters.

The data presented in **Table 1** and **Figure 1** revealed that there were significant differences in terms of plant height and plant spread among the varieties. Among the varieties, growth in terms of plant height (18.62 cm) and spread (27.36 cm) of Subarina (V_2) was more vigorous than the rest of the varieties. On the other hand, minimum plant height (13.18 cm) and plant spread (18.83 cm) were observed in Eliyana (V_5). The variation in plant height and plant spread might be due to the genetic makeup of the varieties. Results of present investigation regarding plant height were in partial agreement with the findings of Rahman *et al.* (2013).

The cultivation situations did not have significant influence on plant height and plant spread. Maximum plant height and plant spread was recorded in poly house condition (S_2) whereas minimum plant height and plant spread was recorded in net house condition (S_3). It might be due to the prevalent environmental conditions in poly house which influenced the growth of strawberry cultivars.

Table 1: Plant Height (cm) and Plant Spread (cm) of Different Varieties of Strawberry in Different Cultivation Situations

Treatments	Plant Height				Plant Spread			
	S_1 (Open)	S_2 (Poly house)	S_3 (Net house)	Mean	S_1 (Open)	S_2 (Poly house)	S_3 (Net house)	Mean
V_1 (Cristal)	16.23	15.9	15.11	**15.75**	21.03	21.37	21.01	**21.14**
V_2 (Subarina)	19.68	18.76	17.42	**18.62**	28.24	27.3	26.55	**27.36**
V_3 (Sweet Charlie)	14.4	15.07	12.64	**14.04**	20.11	20.69	18.23	**19.68**
V_4 (Winter Dawn)	13.52	16.4	13.55	**14.49**	19.6	21.51	20.33	**20.48**
V_5 (Eliyana)	12.39	16.02	11.12	**13.18**	17.65	20.59	18.23	**18.83**

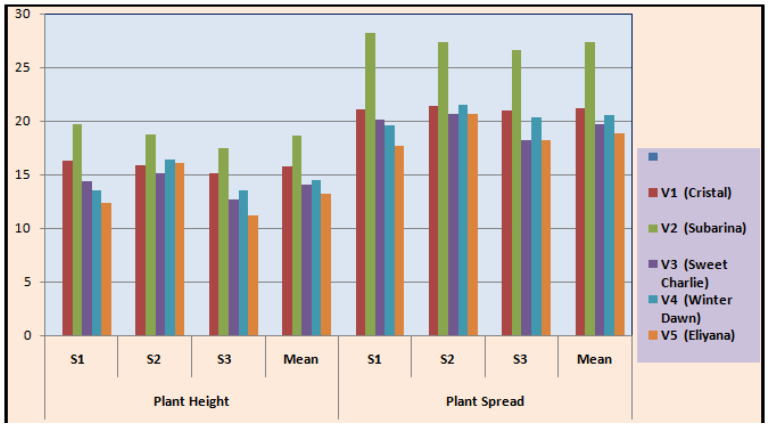


Figure 1: Plant Height and Plant Spread of Different Varieties of Strawberry in Different Cultivation Situations

The data presented in **Table 2** and **Figure 2** revealed that the maximum number of leaves per plant (18.42) was counted in Subarina (V_2) and the minimum number of leaves (9.85) was produced by Sweet Charlie (V_3) and Eliyana (V_5). The present finding is in conformity with the results of Rao and Lal (2010) and they justified that the number of leaves produced by the plants of different varieties differed mainly due to the inherent characters of the varieties. Cultivation situations did not have significant influence on number of leaves per plant. Highest value of number of leaves per plant was found in open condition (S_1) whereas lowest value was found in net house condition (S_3). It might be due to exposure of the plants to the direct sunlight and precipitation and better air movement availed in open condition.

The size of the leaves which includes leaf length and leaf breadth varied significantly among the varieties. Subarina (V_2) recorded longest leaf (8.39 cm) which was at par with Cristal (V_1)(8.36 cm) while shortest leaf (7.66 cm) was recorded in Winter Dawn (V_4). On the other hand, maximum leaf breadth (13.50 cm) was recorded in Cristal (V_1) which was at par with Subarina (13.27 cm) while the minimum leaf breadth (12.46 cm) was recorded in Winter Dawn (V_4) which was at par with Sweet Charlie (V_3)(12.48 cm). The higher leaf area in these varieties might be due to more available metabolites and their allocation to the above ground parts of the plants through roots and genetic attributes of respective cultivars. Tanaka and Mizuta (1974) reported that variation with respect to leaf area among different cultivars could be attributed to influence of different photoperiod, temperature and soil nutrient status. Leaf length was not influenced significantly by the cultivation situations but the leaf breadth was significantly influenced by the situations of cultivation. Maximum leaf breadth (13.57 cm) was recorded in open condition (S_1) whereas minimum leaf breadth (12.37 cm) was recorded in poly house condition (S_2). The variation in result might be due to the imbalance in soil nutrients or might be due to some other climatic factors.

Table 2: No. of Leaves per Plant, Leaf Length (cm) and Leaf Breadth (cm) of different Varieties of Strawberry in Different Cultivation Situation

Treatments	No. of Leaves Per Plant				Leaf Length (cm)				Leaf Breadth (cm)			
	S_1 (Open)	S_2 (Poly house)	S_3 (Net house)	Mean	S_1 (Open)	S_2 house)	S_3 house)	Mean	S_1 (Open)	S_2 house)	S_3 house)	Mean
V_1 (Cristal)	10.5	10.17	9.27	**9.98**	8.48	8.54	8.06	**8.36**	14.15	13.22	13.15	**13.5**
V_2 (Subarina)	21.38	16.11	17.78	**18.42**	8.59	8.33	8.25	**8.39**	14.45	12.39	12.98	**13.27**
V_3 (Sweet Charlie)	11.33	9.88	8.33	**9.85**	8.12	7.74	8.07	**7.97**	13.05	11.96	12.44	**12.48**
V_4 (Winter Dawn)	11	10.55	10.89	**10.81**	7.87	7.45	7.68	**7.66**	13.09	11.85	12.43	**12.46**
V_5 (Eliyana)	9.72	10.33	9.5	**9.85**	7.81	7.43	8.1	**7.78**	13.11	12.44	12.39	**12.65**

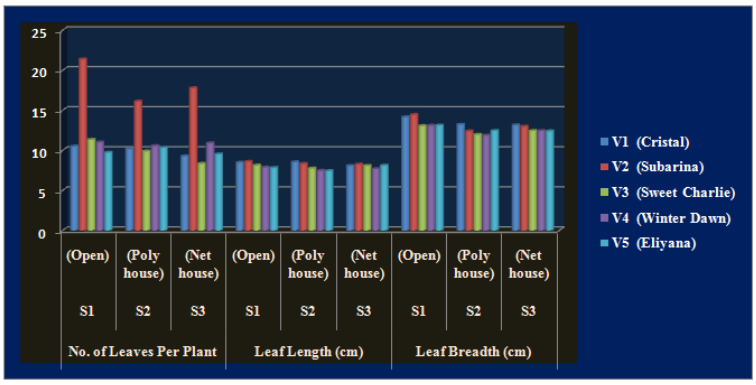


Figure 2: No. of Leaves per Plant, Leaf Length (cm) and Leaf Breadth (cm) of Different Varieties of Strawberry in Different Cultivation Situation

Length of the petiole differed significantly among the varieties of strawberry and it ranged from 9.12 cm (Subarina) to 7.25 cm (Eliyana). No significant difference in leaf petiole length with respect to the cultivation situations was found. Longest leaf petiole (8.21 cm) was recorded in poly house condition (S_2) while the shortest leaf petiole (7.92 cm) was recorded in open condition (S_1) which was at par with the net house condition (7.99 cm). The variation in petiole length recorded in the present study might be due to the controlled environmental conditions provided in protected cultivation or it may be due to the preference of some varieties to protected cultivation rather than open condition.

The varieties differed significantly in terms of achene density. Maximum achene density (19.12/cm^2) was recorded in Cristal (V_1) which was at par with Subarina (V_2) and Eliyana (V_5) and the number of achenes present in the fruits of Sweet Charlie (V_3) (17.81/cm^2) exhibited significantly least to all other varieties. The variation in achene density between the varieties might be due to the genetic characters or differences in environmental factors. The result of the present investigation is closely in conformity with the results of Bakshi *et al.* (2014). Cultivation situations did not influence the number of achenes per cm^2 of fruit skin significantly.

In the present investigation, significant differences were noticed in relation to crown number per plant. Maximum number of crown per plant (5.53) was produced by Subarina (V_2) which was significantly higher than the other varieties of the experiment and minimum number of crown (2.01) was recorded in Eliyana (V_5) among all the varieties. The present finding is more or less in conformity with the results of Rahman *et al.* (2013).

The number of crowns per plant did not differ significantly due to the effect of cultivation situations. In open

condition (S_1), the number of crowns per plant was higher while the minimum was found in net house condition (S_3).

Yield Parameters

Number of fruits per plant, weight of fruits, fruit length, fruit diameter, fruit production (kg/plant) and yield (t/ha) were considered as yield parameters in strawberry.

In the present experiment, significant differences in yield parameters were observed among the varieties selected. In consideration of these yield parameters, Subarina (V_2) was found to be significantly superior among the varieties. It might be related to the better growth parameters *i. e.* higher plant height, plant spread, higher number of leaves recorded in Subarina (V_2). The hereditary characters of the varieties might be considered to be the variation in yield parameters among the varieties as they were grown in similar environment and with equal management practices. These results were in conformity with the findings of Jami *et al.* (2015) and Recupero *et al.* (1989) who reported that there were significant differences among the varieties in relation to yield parameters.

From the **Table 3** and **Figure 3** it is revealed that the number of fruits per plant was significantly influenced by the situations where the strawberry plants were cultivated. In open condition (S_1), the number of fruits per plant was highest (17.50) and in poly house (S_2) the number of fruits per plant was minimum (15.48). The present finding is in close proximity with the findings of Awang and Atherton (1995).

The different varieties studied in the present experiment showed significant variation in their fruit weight which had positive effect on fruit yield. The variety Subarina produced maximum fruit weight (16.45 g) followed by Sweet Charlie (12.27 g) whereas minimum fruit weight was recorded by Eliyana (11.30 g) and Cristal (11.31 g). Significant variation was noticed in case of fruit weight in different cultivation situations where the plants were grown. Highest fruit weight was observed in open condition and the lowest was observed in net house condition. This might be due to maximum interception of sunlight and higher production of photosynthates enabling the plants to produce bigger fruits in open condition. Significant differences also noticed in terms of fruit length in different cultivation situations. Longest fruit was observed in open condition and shortest fruit was observed in net house condition. The value of fruit diameter was non-significant in different cultivation situations where strawberry was planted.

Fruit production (g/plant) and fruit yield (t/ha) were significantly influenced by different cultivation situations. Among the varieties, highest number of fruits was recorded in the variety Subarina (18.04 no./plant) while the lowest fruit production was observed in Eliyana (15.70 no./plant). Riyaphan *et al.* (2005) and Perez-de-Camacaro *et al. (*2002) found that the number of inflorescences per plant significantly varied in strawberry cultivars, which are in close conformity with the present findings. In open condition, the fruit production (g/plant) and fruit yield (t/ha) were considerably higher as compared to cultivation in poly house and in net house. The highest fruit production (g/plant) and fruit yield (t/ha) in open condition could be attributed to the higher production of fruits per plant, heavier individual fruit production, longer and broader fruits recorded in open condition in the present investigation.

Table 3: No. of Fruits per Plant, Fruit Weight (g) and Fruit Length (cm) of Different Varieties of Strawberry

Treatments	No. of fruits per plant				Fruit weight (g)				Fruit Length (cm)			
	S_1 (Open)	S_2 (Poly house)	S_3 (Net house)	Mean	S_1 (Open)	S_2 (Poly house)	S_3 (Net house)	Mean	S_1 (Open)	S_2 (Poly house)	S_3 (Net house)	Mean
V_1 (Cristal)	16.81	15.9	15.53	**16.08**	12.21	11.18	10.56	**11.31**	3.55	3.42	3.41	**3.46**
V_2 (Subarina)	18.73	16.77	18.61	**18.04**	19.4	15.74	14.22	**16.45**	4.25	4.01	3.99	**4.08**
V_3 (Sweet Charlie)	18.08	14.05	16	**16.04**	13.37	12.24	11.21	**12.27**	3.76	3.35	3.15	**3.42**
V_4 (Winter Dawn)	17.18	15.8	17	**16.66**	12.85	10.87	9.99	**11.24**	3.65	3.28	2.96	**3.3**
V_5 (Eliyana)	16.71	14.88	15.51	**15.7**	12.41	11.72	9.78	**11.3**	3.51	3.39	2.87	**3.26**

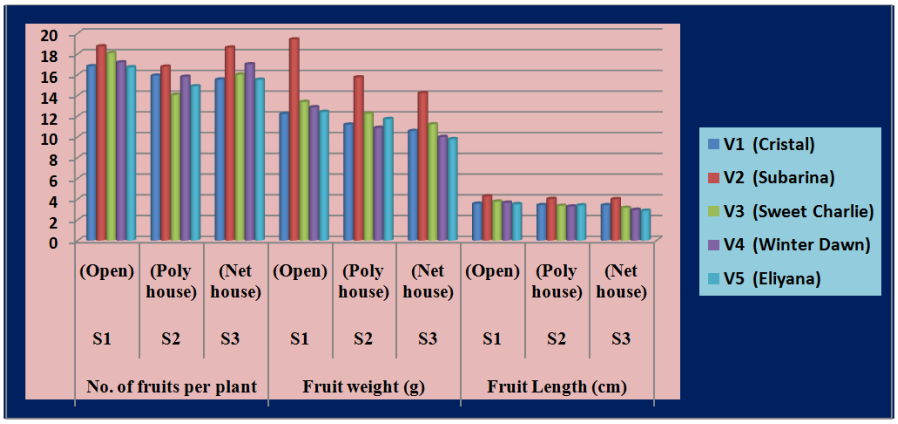


Figure 3: No. of Fruits per Plant, Fruit Weight (g) and Fruit Length (cm) of Different Varieties of Strawberry

CONCLUSIONS

The results of the experiment revealed that the performance in terms of vegetative growth and production of fruits were superior in Subarina as compared to other four varieties irrespective of different environmental conditions. Therefore, from this experiment we can conclude that the variety Subarina (V2) is having highest adaptability in the prevailing climatic condition of Assam.

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